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(71) Applicant
Rostovsky Nauchno-Issledovatelsky Institutekhnologii Mashinostroenia (RostNIITM)

(Incorporated in the Soviet Union)

Rostov-na-Donu, ulitsa Metallurgicheskaya 102/2, Soviet Union

(72) Inventors
Jury Leibovich Perevozkin
Anatoly Aramovich Mkrtychian
Vitaly Filippovich Zharkov
Jury Ivanovich Khvastukhin

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(74) Agent and/or Address for Service
A A Thornton & Co
Northumberland House, 303-306 High Holborn, London, WC1V 7LE, United Kingdom

(54) Method for removing wax-like pattern material from shell molds

(57) The method consists in short-time treatment of a block of patterns of wax-like pattern material covered by a refractory shell by blowing onto the block, steam having a temperature of 110–140°C during 5 to 90 seconds. The surface layer of the pattern material melts very quickly and a gap is formed between the pattern and shell. After that this block is treated with hot air. By this all pattern material is heated, melted, and removed from the shell.

The steam treatment for a short time permits the use of water soluble binding materials for making the shell, and the initial melting of the pattern surface layer avoids expansion of the unmelted core, exerting stress upon the refractory shell which would cause it to crack.

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METHOD FOR REMOVING WAX-LIKE PATTERN MATERIAL FROM SHELL MOLDS

The invention relates to metal casting and deals with making molds by the lost-wax method, and more specifically, the invention relates to a method for removing a wax-like pattern material from shell molds.

The process of removing a wax-like pattern material from molds by melting is associated with a risk of shell cracking. This is explained by the fact that the wax-like pattern material expands under heating to exert action upon the shell which is made up of several layers of refractory materials and binders such as quartz and ethyl-silicate binder or quartz and water glass. Accelerated heating may eliminate the danger of crack formation because the surface of the pattern material will be fused before the volume of the pattern material will have increased so as to present any danger. Rapid heating of the block of patterns having layers of a shell mold applied thereto is one of primary conditions for appropriate conduct of the process of removal (melting-out) of patterns. Consequently, many reported developments were aimed at accelerating the heating of the pattern material.

Known in the art are methods comprising heating blocks of patterns coated with a shell and allowing them to stay in a steam autoclave at high pressure. Thus, according to one known method (cf. GDR patent No.136220, Cl. B 22 c 1/20, June 27, 1976), blocks of patterns coated with a shell are treated in an autoclave with saturated steam at a pressure of 3.5 kgf/cm^2 during 10-15 minutes,

whereafter normal pressure is established in the autoclave. Another method comprises allowing blocks of patterns coated with a shell to stay in an autoclave at 160-180°C at a steam pressure of 7 bar.

The above methods ensure a high rate of heating and melting of the layer of pattern material which is disposed immediately adjacent to the shell. Owing to a space forming upon melting of the pattern material, expansion of the remaining pattern material does not cause pressure application to the shell, and if such pressure is applied, it cannot result in breakage of the shell. However, use of these methods calls for complicated equipment operating in a batch manner thus resulting in certain difficulties under the flow-line mass production conditions. In addition, heating and curing shells based on water-soluble binders in autoclaves lowers their strength.

Known in the art is a method comprising acting upon a blocl of patterns coated with a shell with hot air (cf. Shklennik Ya.I. et al., Investment Casting, 1971, Moscow, Mashinostroenie Publishing House, pp. 240-242). This method makes it possible to simplify equipment and allows a continuously operating conveyor installations to be used which is very important for the flow-line masse production. The method allows water-soluble materials to be used for shell molds. However, owing to a low heat transfer capacity of air, heating of the pattern material occurs rather slowly thus resulting in a substantial expansion of the pattern material before its surface layer

has time to melt. Pressure of the expanding pattern material on the shell causes its breakage.

Also known in the art is a method, wherein a block of patterns coated with a shell mold is immersed for 3-5 minutes in water at 90-95°C, with subsequent treatment with hot air (SU, A, No.349468). As water has a higher heat transfer capacity as compared to air, heating and melting of the surface layer of the pattern material are accelerated. This results in a space being formed between the shell and the remaining part of the pattern so that the pattern material is allowed to expand freely when acted upon with hot air. However, allowing shell molds to stay in hot water lowers their strength and, in case water-soluble binders such as water glass are used, results in a loss of strength.

Therefore, neither of the prior art methods for removing patterns can ensure use of water-soluble binders for making a shell without a loss of strength.

It is an object of the invention to provide a method for removing a pattern material from shell molds which makes it possible to retain strength of the shell molds while at the same time allowing water-soluble binders to be used for making the shell.

This object is accomplished by that in a method for removing a wax-like pattern material from shell molds, comprising a short-time treatment of a block of patterns coated with a shell with a high heat transfer capacity heat carrier, with subsequent treatment of said block of

patterns with hot air, according to the invention, the high heat transfer heat carrier is in the form of steam at 110-140°C, the treatment being carried out during 5 to 90 seconds.

A block of patterns coated with a shell made on the basis of a water-soluble binder is treated with steam during 5 to 45 seconds.

A block of patterns coated with a shell made on the basis of a water-resistant binder is treated with steam during 5 to 90 seconds.

The pretreatment of a block of patterns with steam results in a substantial acceleration of heating and fusion of the layer of a wax-like pattern material disposed adjacent to the shell. With the employment of steam heat transfer increases 5-7 times as compared to the prior art method making use of hot water as heat carrier for pretreatment. This advantage of the invention makes it possible to achieve a substantial reduction of losses of shell molds at the pattern removal stage so as to lower the specific consumption of mold materials in lost-wax casting. In addition, the method allows water-soluble materials such as water glass to be used, whereas the prior art method does not make it possible to use water-soluble binders.

The method does not call for special equipment, and it may be easily carried out in conventional plants designed for removing pattern material from shell molds.

The detailed description of the method according to the invention will be given below.

The process is conducted in a conveyor plant having at the inlet end thereof a hot air chamber and an apparatus for treating blocks of patterns coated with a refractory shell, with steam.

Blocks of patterns moving along a conveyor and coated with a shell are treated with steam jets at 110-140°C.

If steam temperature is below 110°C, condensate may deposit in the pipelines and mix with steam. The efficiency of the method is lowered if the blocks are treated with such mixture.

The method according to the invention may also be carried out with a steam temperature above 140°C, but this will entail use of more sophisticated equipment and higher energy consumption. Therefore, it is inexpedient to use steam at a temperature above 140°C for carrying out the method according to the invention.

The time of steam treatment of the blocks depends on materials used for making shell molds and on the number of layers. In case shell molds are made of water-soluble binders such as water glass, the treatment is carried out for 5 to 45 seconds. Five seconds is the minimum time necessary for heating the mold through so as to fuse the surface layer of the pattern material in a four-ply shell which is widely used in large-capacity precision casting workshops.

Forty five seconds is the time necessary to heat through the surface layer of a pattern material for fusion with a 12-ply shell. Treatment for a time longer than 45 seconds when water-soluble materials are used in the shell is undesirable since a loss of strength of the shell may ensue.

In case water-resistant materials are used for making the shell, the upper limit of the steam treatment time is 90 seconds. This is the time sufficient to heat through the layer of the pattern material for fusion with any practically reasonable number of shell layers. A treatment for a time longer than 90 seconds is inexpedient owing to unwarranted increase in energy consumption.

Better understanding of the invention may be had from the following examples illustrating specific embodiment of the method.

Example 1

A block of paraffin-based patterns coated with a 4-ply shell made of pulverulent quartz, quartz sand and ethyl-silicate (for the first two layers) and water glass (for the third and fourth layers) is placed on a through--type conveyor plant for moving said blocks to a hot air chamber. At the inlet of the chamber, the moving blocks are treated with steam at 140°C by jet blowing during 5 seconds. A rapid fusion of the surface layer of the pattern material occurs, and a space is formed between the pattern and shell. The conveyor then moves the blocks within the chamber to which air heated at 200°C

is supplied. During movement within the chamber, complete melting of the pattern material and its removal from the shells take place.

The shells devoid of the pattern material retain their integrity and strength. Ultimate static bending strength of the shells is 5.7-5.9 MPa.

Example 2

Blocks of paraffin-based patterns coated with a 8-ply shell made of pulverulent quartz, quartz sand and ethyl-silicate (for the first five layers) and water glass (for the remaining three layers) are placed on a conveyor of a through-type plant for moving said blocks into a hot air chamber. At the inlet of the chamber, the blocks are treated with steam at 125°C by jet blowing during 45 seconds. A rapid fusion of the surface layer of the pattern material occurs, and a space is formed between the pattern and shell. The conveyor then moves the block within the chamber for 25 minutes, and air heated at 200°C is supplied to the chamber. During movement within the chamber, complete melting of the pattern material and its removal from the shells take place.

The shell molds devoid of the pattern material retain their integrity and strength. Ultimate static bending strength of the shells is 5.1-5.4 MPa.

Example 3

Blocks of paraffin-based patterns coated with 12--play shell made using pulverulent quartz, quartz sand

and ehtyl-silicate for all layers are placed on a conveyor of a through-type plant for moving said blocks to a hot air chamber. At the inlet of the chamber, the moving blocks are treated with steam at 110°C by jet blowing during 90 seconds. The surface layer of the pattern material is rapidly fused, and a space is formed between the pattern and shell. Then the conveyor moves the blocks during 25 minutes within the chamber to which hot air heated at 200°C is supplied. During movement within the chamber, complete melting of the pattern material and its removal from the shells take place.

The shell molds devoid of the pattern material retain their integrity and strength. Ultimate static bending strength of the shells is 5.5-5.7 MPa.

Example 4

This example is given to illustrate a prior art method wherein the heat carrier for pretreatment of the blocks is hot water.

Blocks of paraffin-based patterns coated with a 4-ply shell made using pulverulent quartz, quartz sand and ethyl-silicate (for the first two layers) and water glass (for the third and fourth layers) are immersed in water heated at 95°C and are allowed to stay therein during 4 minutes. This causes fusion of the surface layer of the pattern material with the formation of a space between the pattern and shell. At the same time, the third and fourth layers are soaked, and glass is dissolved in hot water thus resulting in a loss of strength of these layers. The conveyor then moves the

blocks for 25 minutes within the chamber to which air heated at 200°C is supplied. When the blocks move within the chamber, complete melting of the pattern material and its removal from the shell take place. As a result of a material loss of strength of the shell layers made with the employment of water glass, all molds have manifestations of breakage. Ultimate static bending strength is 1.7-1.9 MPa.

Example 4 confirms that it is not possible to use a water-soluble binder in the prior art method.

Examples 1 through 3 support advantages of the method according to the invention over the prior art. The method according to the invention makes it possible to retain integrity and strength of the shell mold while, at the same time, allowing water-soluble binders to be used for making shells, No sophisticated and expensive equipment such as autoclaves is required for carrying out the method according to the invention. The method according to the invention may be carried out on a continuous basis which is especially important for mass production conditions.

WHAT WE CLAIM IS: -

1. A method for removing a wax-like pattern material from shell molds, comprising a short-time treatment of a block of patterns coated with a shell with a heat carrier exhibiting a high heat transfer capacity, with subsequent treatment of said block with hot air, wherein the heat carrier is in the form of steam at 110-140°C, the steam treatment of the block of patterns coated with a shell being carried out during 5 to 90 seconds.

2. A method according to claim 1, w h e r e i n a block of patterns coated with a shell based on a water-soluble binder is treated with steam during 5 to 45 seconds.

3. A method according to Claims 1 and 2, substantially as described herein above with reference to Examples 1-3.